DOCUMENT RESUME

ED 055 819 SE 012 223

AUTHOR Lett, Rosemary, Ed.
TITLE Science, A Teacher's Guide, Grades 4-6.
INSTITUTION Buffalo Public Schools, N.Y.
PUB DATE 69
NOTE 47p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Curriculum; Curriculum Guides; *Elementary School Science; Scientific Concepts; *Teaching Guides

ABSTRACT

This teacher's guide to science in grades 4, 5, and 6 in the Buffalo Public Schools, New York, lists content areas for each grade level. Concepts or understandings to be developed for each content area are listed. Appropriate text and teacher guide pages are given to the science series developed by Herman and Nina Schneider to reinforce these broad objectives and relationships. (BB)

ED055819

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

SCIENCE

A TEACHER'S GUIDE

GRADES 4 - 6

BUFFALO PUBLIC SCHOOLS BUFFALO NEW YORK
DIVISION OF CURRICULUM EVALUATION AND DEVELOPMENT

1969

SE 012 245

ED055819

BUFFALO PUBLIC SCHOOLS
BUFFALO, NEW YORK

Superintendent of Schools - Dr. Joseph Manch

Board of Education

Dr. Bernard S. Rosenblat, President
George F. Goodyear, Vice-President
Joseph E. Murphy
Dr. George E. Blackman
Dr. Matt A. Gajewski
Anthony J. Nitkowski
Carmelo A. Parlato

Prepared Under the Direction of:

Alfred J. Naish
Director of Science

Editor

Mrs. Rosemary Lett

Division of Curriculum Evaluation and Development
Dr. Frank J. Dressler -- Associate Superintendent

FOREWORD

The Elementary Science Guide represents a departure from traditional curriculum guide approaches. Teachers will recognize quickly that this guide does not list the content areas to be covered at each grade level. Instead it lists general concepts and understandings which children need to learn. The teacher is called upon to use the texts, his own experiences and the experiences of the pupils in order to develop these concepts.

The Elementary Science Program emphasizes the methods that scientists use in gathering and working with information. These include the skills of observation, analysis and prediction. Greater stress is also given to an activity approach where children learn by using all their senses.

This Guide is tentative. Comments and suggestions will be welcomed from teachers and parents throughout the school year. A Curriculum Committee will review these suggestions and make changes that are deemed necessary.

Joseph Manch
Superintendent of Schools

CONTENTS

GRADE FOUR

Page

Foreword 1
Introduction 4
Course Content
The Insect World 5-6
Plants and Seeds 7
Molecules of Matter 8
Causes of Weather 9
Climate and Living Things 10
Water and Living Things 11
Force and Moving Things 12
Machines and Power 13
Earth, Moon and Space 14-15

GRADE FIVE

Course Content
The Weather Forecast 16-17
Earth and Space Navigation 18-19
Matter and Energy 20
Mechanical and Heat Energy 21
Chemical and Nuclear Energy 22-23
Electricity 23-24
Your Body and Growth 25
Animals on Our Planet 26
Plants on Our Planet 27
Geology: Earth's Forces 28
Conservation: Soil and Water 29
Geology: Mineral Treasures 30

CONTENTS

GRADE SIX

	Page
Course Content	
Basic Chemistry	31-32
Sunlight and Life	32
Prehistoric Life	33
Sound Waves	34
Sound and Communication	35
Light Waves	35-36
Optical Instruments	37
Radio and Television	37
The Nervous System	38
Astonomy: Time and Space	39
Theories of Astronomy	40
Oceanography and Engineering	41-42

INTRODUCTION

To achieve the goal of developing in the child an understanding that science involves everything around us, teachers should strive to instill in children skill in developing a growing awareness of their constantly changing environment, its interdependence and interrelationships between living things and their environments. The child will begin to realize he is a complex being playing his part in the complex structure of the world.

The tools of the scientist, observation, collection, organization and interpretation of data, collection and classification of specimens with recognition of relationships and patterns, and experimentation are fascinating to even the youngest child.

The following guidelines are intended as statements of the broad concepts to be gained by the children in grades K-6.

Children could arrive at the basic understandings through a discovery of causes, relationships and effects. Learning of certain facts is very necessary in science to explain and support these major concepts. However, stressing of minute details does not guarantee a child's understanding of a concept and its relative value in the world.

The science series by Herman and Nina Schneider has been carefully selected as the text to be followed in the K-6 program. It is urged that the preface material to the teachers' guide be carefully read since it provides a launching platform for the program.

Specific aims for each unit are clearly listed according to pages on which they are presented. General suggestions of methods, correlating material and procedures are given. Naturally, the judgment of the teacher is needed to decide whether or not certain material and activities are suitable for fulfilling the needs of a particular class. Definitely optional material is listed at each grade level in the following printed guide. This guide summarizes specific aims as broad objectives and relationships. Reference is given to pages which present the specific material to aid in developing the broad concepts.

Each text contains supplemental inserts referred to as Process Blocks. They provide for added activities involving the processes which scientists utilize. Creativity and independent thought will be furthered through their use, where and when applicable. The teacher's guide explains each thoroughly.

GRADE FOUR

THE INSECT WORLD

GENERAL CONCEPTS	REFERENCES
Reinforce concepts developed in previous grades.	References to text and teacher's guide. T. - Text pages G. - Guide pages
Insects are the largest and most widespread group of animals. (3/4 of all animals)	G. - 381
Insects have become adapted to their particular environment almost everywhere on earth.	T. - 1 G. - 363
Insects have particular physical and biological characteristics which separate them from all other animal groups. Such characteristics are useful for classification purposes.	T. - 4-8, 9-12 G. - 367-69
Great numbers of insects survive since each type lays many eggs in different places and have natural camouflage characteristics.	T. - 13, 16-17 G. - 369-71
Insects have their own system of communication and of locating each other.	T. - 14-15 G. - 369-70
Certain insects have adapted to community living and are termed social insects.	T. - 19-23 G. - 372-74

The Insect World (Cont.)

GENERAL CONCEPTS	REFERENCES
Insects serve man in many ways, yet some can cause great damage.	T. - 25-28 G. - 372, 374-76
Scientists have developed methods of controlling harmful insects. Caution must be exercised so as to not kill helpful insects or birds. (Balance of nature preserved)	T. - 25-28 G. - 372, 374-76
Most insects are dependent on plants for their food.	T. - 25-27 G. - 374-75
Observation and collection of insects and their immediate environment broadens a child's understanding of nature.	T. - 2-3, 24, 29 G. - 364, 373-74

PLANTS AND SEEDS

GENERAL CONCEPTS	REFERENCES
Flowering plants produce seeds. Seeds differ in different plants.	T. - 30-31, 37-39, 40-45, 48 G. - 384
Each plant and flower has parts which serve definite functions in its life and the process of reproduction.	T. - 32-34, 37-39 G. - 384-85
Many plants are dependent on insects for aiding in pollination. Pollen may be transferred in other ways.	T. - 34-35, 48 #1 & 2 G. - 386
Man eats different parts of different plants.	T. - 39-40 G. - 386
All seeds contain a young plant and stored food.	T. - 42-45 G. - 387
Some plants may be grown from parts other than the seed.	T. - 43 G. - 387-89
Seeds are adapted for various methods of disposal.	T. - 46-47 G. - 389-90

MOLECULES OF MATTER

GENERAL CONCEPTS	REFERENCES
Matter takes up space and has weight.	
A molecule is the smallest single particle of a substance that possesses the properties of that substance.	T. - 54-56 G. - 398
Molecules are constantly in motion.	T. - 57 G. - 400-2
There is a relationship between temperature change and molecular motion. A change in the state of matter is the result of the change in the motion of the molecules in the matter and the space between molecules.	T. - 58-63, 70-73 G. - 401-03, 423
Molecules behave differently in different states of matter.	T. - 64-69 G. - 404-06
We need molecules of oxygen in order to live.	T. - 74 G. - 409
Air takes up space.	T. - 76-77 G. - 410
The striking of air molecules against a surface causes air pressure.	T. - 78-83 G. - 410-18

CAUSES OF WEATHER

GENERAL CONCEPTS	REFERENCES
Changes in the weather are the result of changes in the amount of heat from the sun that reaches the earth, the movement of the atmosphere (winds), and changes in the amount and state of the weather in the atmosphere.	
Weather is the condition of the atmosphere for a short time.	T. - 92-94 G. - 426-27
Air and water temperature changes occur at different rates when exposed to the same amount of sunlight.	T. - 94-103 G. - 427-30
The principle of the water cycle is important in understanding the variations in weather.	T. - 112, 118-21 G. - 431-4, 436
Different forms of precipitation are the result of air temperatures.	T. - 112-120 G. - 431-36
The causes of a great variety of weather phenomena can be explained.	T. - 115-17 G. - 435-36

CLIMATE AND LIVING THINGS

GENERAL CONCEPTS	REFERENCES
There are regions of extreme heat and cold on earth due to the tilt of the earth on its axis and revolution of the earth around the sun.	T. - 125-28, 131-45 G. - 445-46
Climate is the average condition of the atmosphere over a long period of time. Many factors determine the climate of a region.	T. - 131-45, 156-57, 167-71 G. - 446-49, 452-53, 454-55
Animals, including man, have adaptations for living in their particular environment.	T. - 146-54 G. - 449-53
Since animals depend on plants for food, nature has provided for plant adaptations. This helps show the interdependence of plant and animal life.	T. - 150-54, 158-61 G. - 452-53
Scientists have divided the earth into broad climatic zones. Within these zones there are variations that are caused by geographic features.	T. - 164-66 G. - 454
The topography and latitude of a region determine the types of plants and animals found in that region.	T. - 167-71 G. - 454-55
All maps show some distortion of the earth's forms. The globe is the most accurate representation.	T. - 129-30 G. - 446

WATER AND LIVING THINGS

GENERAL CONCEPTS	REFERENCES
Living things need water to sustain life.	T. - 175-76 G. - 462-63
Water has properties which identify it.	T. - 177-78 G. - 462-63
Water can exist in three states. The liquid state is most useful.	T. - 177-79 G. - 462-63
Plants and animals are composed mainly of water.	T. - 180-81 G. - 464-65
Water serves a multitude of purposes for animals and plants.	T. - 181-87, 178-79 G. - 462-66
Protoplasm (living substance) is composed chiefly of water and is generally contained in unit packages called cells.	T. - 188-94 G. - 466-68
Water is utilized in every system in the human body.	T. - 194-209 G. - 469-73
An awareness of the functions and operation of the respiratory and circulatory systems increases the understanding of how our bodies work.	T. - 194-209 G. - 469-73

FORCE AND MOVING THINGS

GENERAL CONCEPTS	REFERENCES
All types of travel (or motion) involve three basic factors: 1. a force 2. something to push against 3. a resistance that is less than the force	T. - 220-24, 235 G. - 481, 484-85
Friction is the name given to the resistance of one object rubbing against another.	T. - 223-24 G. - 481-82
Scientists have discovered methods of reducing friction.	T. - 224-31 G. - 481-83
The presence of friction is often an advantage to man.	T. - 232-34 G. - 483
Newton's Third Law of Motion is easily illustrated in water transportation. This principle has been applied to aeronautics in the construction of different types of aircraft.	T. - 235-51 G. - 484-98, 503

MACHINES AND POWER

GENERAL CONCEPTS	REFERENCES
Energy is the ability to do work. Work is done when a force (push or pull) moves something.	T. - 255-56 G. - 506-07
Muscle power was the first source of energy used by man.	T. - 255-56 G. - 506-07
Man discovered how he could use natural sources of energy (wind, water) to do his work.	T. - 256-70 G. - 507-11
Scientists have developed engines and motors which use different forms of energy to operate machines.	T. - 264-79 G. - 511-14
Engines and motors aid man in producing food, clothing and shelter.	T. - 274-79 G. - 513-15

EARTH, MOON AND SPACE

GENERAL CONCEPTS	REFERENCES
The universe encompasses all that exists. "The universe consists of all known and unknown mass in any form and the empty space between.	Throughout Unit
All bodies in space have distinguishing characteristics.	
Measuring devices are necessary tools of the astronomer to understand spatial relationships.	
There is an orderly pattern of motion among heavenly bodies. Some bodies and their motion have an effect on the earth. Some motions may be observed; others, because of distance are too infinitesimal to see.	T. - 286, 290-92, 292-5 G. - 525-31
Rotation and revolution are motions distinct from one another. Our time units are derived from the periods of the earth's rotation and revolution.	T. - 290-91 G. - 526-29
The number of daylight hours and the directness (angle) of the sun's rays cause variations of the heating effect of the sun.	T. - 297, 299-300 G. - 531-32

Earth, Moon and Space (Cont.)

GENERAL CONCEPTS	REFERENCES
The difference between the force of gravity on the moon and on the earth has produced many differences in the physical characteristics of the earth and the moon.	T. - 297-300 G. - 531-32
Natural forces on the earth's surface or in its atmosphere produce continual physical changes of the earth's surface.	T. - 301-02
The effect of the moon's gravitational force on the earth appears in the presence of predictable tides.	T. - 303-09 G. - 532-33
Through the centuries some water animals have adapted to living without water along the seashore between high tides.	T. - 306-07
Knowledge and timing of tides are important to many of man's activities involving the seas.	T. - 308 G. - 532-34

GRADE FIVE

THE WEATHER FORECAST

GENERAL CONCEPTS	REFERENCES
Reinforce concepts developed in previous grades.	References to text and teacher's guide. T. - Text pages G. - Guide pages
The terms climate and weather are different in meaning.	
The factors which influence weather are interdependent rather than isolated.	Entire Unit
Weather plays a major role in everyday life. Certain occupations are more dependent on weather reports and forecasts than others.	T. - 1
Scientists have developed devices that enable meteorologists to study weather factors and provide for long-range forecasting.	T. - 1-3, 30-33 G. - 397-99, 406-08
Great differences in temperature at the poles and the equator contribute to the origin of winds.	T. - 6-19 G. - 400
Weather instruments constructed in the classroom are not scientifically and mathematically accurate but are capable of showing changes.	T. - 8-9, 22-23, 27-28 G. - 400, 402-03, 405-07

The Weather Forecast (Cont.)

GENERAL CONCEPTS	REFERENCES
Weather is the change in the earth's atmosphere in a particular region over a short period of time.	T. - 13-23 G. - 401-04
The atmosphere, several hundred miles in depth, possesses different characteristics at different heights.	T. - 13-19 G. - 400-02
Changes in the atmosphere can be measured by instruments, recorded manually or automatically and then interpreted by meteorologists. Predictions of future weather conditions are made from the data obtained.	Throughout Unit
The water cycle has a major role in the causes of changes in the weather.	T. - 19-30 G. - 402-07
Observation, recording and reading of data improve the child's perception and skills in interpretation.	Entire Unit

21

EARTH AND SPACE NAVIGATION

GENERAL CONCEPTS	REFERENCES
Navigation in space is based on our knowledge of the earth and space and requires the use of mathematics and specialized instruments.	
There are visible proofs that the earth is a sphere.	T. - 39-43 G. - 416-18
Navigators used their knowledge of stars and constellations to determine time, place and direction.	T. - 41 G. - 416
A knowledge of prevailing winds and ocean currents is important to navigators of aircraft and ships.	T. - 44-48 G. - 418-19
Magnetic forces differ from gravitational forces. Magnetism may be attraction or repulsion; gravity can only be attraction. Substances can change from a magnetized to demagnetized state.	T. - 49-50, 70 G. - 419-20
Latitude and longitude simplify the location of points on a globe.	T. - 52-57 G. - 420-21
Conditions change as we move from the surface of the earth into ocean depths or through the atmosphere and into space. Instruments that measure these changes are used in undersea or space navigation.	T. - 60-66 G. - 422-24

Earth and Space Navigation (Cont.)

GENERAL CONCEPTS	REFERENCES
Instruments have been developed to measure heights, depths and distances beyond the physical reach of man.	T. - 61-63 G. - 422
Gravity is a universal force. All bodies exert this force upon one another. The amount of the force depends on the mass of each substance and the distance between the bodies. The force of gravity between two objects never becomes zero.	T. - 67-71 G. - 423-24
The layers of the atmosphere possess different characteristics.	T. - 67 G. - 423 -24
Navigation in space involves exact calculations of the effect of the force of gravity.	

MATTER AND ENERGY

GENERAL CONCEPTS	REFERENCES
Abstract reasoning power should be developed in this unit.	
Energy is the ability to do work. Work is accomplished only if there is motion.	T. - 83 G. - 430
There are different forms of energy.	T. - 83-84 G. - 430
Energy (mass-energy) cannot be created or destroyed; it can only be changed from one form to another.	T. - 84-88 G. - 430-31
Matter and energy are interrelated.	T. - 89-91 G. - 431-32
Matter is the term for all substances of the world. All matter is made up of particles called molecules which in turn are made up of atoms.	T. - 89-91 G. - 431-32
The attraction between like and unlike molecules holds matter together. The force of attraction is not the same for all molecules.	T. - 92-97

MECHANICAL AND HEAT ENERGY

GENERAL CONCEPTS	REFERENCES
Mechanical energy usually has its origin in another form. Heat energy is often transferred to mechanical energy.	T. - 101-02, 121 G. - 440-41, 446-47
Scientists have developed different units and devices for measuring heat energy and temperature changes.	* T. - 103-04, 110-13, 115, 116 G. - 440-41, 443-46
Mechanical energy results when molecules of an object move together as a group.	T. - 100-04 G. - 440-41
Heat is a form of energy resulting from the motion of molecules.	T. - 105-10 G. - 441-43
Heat has an effect on molecular motion.	T. - 105-10 G. - 441-43 437 picture
Heat and temperature, though related, have separate meanings. Temperature is the measure of hotness or coldness of a substance. Heat is the total energy of the molecules due to their motion.	T. - 114
Scientists continue experimenting to determine the best methods of transferring one form of energy to another to provide the greatest efficiency.	T. - 117 G. - 446-47

* Optional - Kelvin Scale, conversions between temperature scales.
Celsius preferred name for Centigrade Scale.

CHEMICAL AND NUCLEAR ENERGY

GENERAL CONCEPTS	REFERENCES
A chemical change occurs when atoms in a material are separated, combined with other atoms or shifted from one molecule to another.	T. - 129-32 G. - 455-56
Chemical and nuclear energy are two of the most important forms of energy.	
During oxidation, energy is released. During photosynthesis, energy is absorbed.	T. - 132-33, 135 G. - 456-58
High-energy substances make chemical changes rapidly, low-energy substances are difficult to change.	T. - 134 G. - 457
One of the most important chemical changes occurs within our bodies.	T. - 131 G. - 455-56, 492-93
Each atom has a definite structure. Nuclear changes release nuclear energy.	T. - 136-40 G. - 458-60
Scientists have learned that by fission or fusion, nuclear energy can be released as heat, light and other forms of energy and put to use.	T. - 140-43 G. - 460-62

GENERAL CONCEPTS	REFERENCES
(See Chapter 3 for mass-energy)	
Scientists use term mass-energy rather than each separately since they have a direct relationship.	T. - 143 G. - 461-62

ELECTRICITY

Electricity, in order to be put to use, must be converted into another form of energy.	T. - 146-47 G. - 468-69
Scientists have discovered a way for electrons to flow from one atom to another through a conductor. This flow is an electron current or electricity. A complete circuit is necessary for the electrons to flow.	T. - 148-51, 161, 165-66 G. - 468-71, 476-77
Two main types of electricity are static and current.	T. - 150-53 G. - 471-73
Electricity may be obtained from a variety of sources.	T - 152-59 G: - 471-76
Electrical quantities are measured in units called amperes, volts, watts.	T. - 159-60 G. - 476

* Math treatment of electrical power optional

Electricity (Cont.)

GENERAL CONCEPTS	REFERENCES
Numerous types of switches aid man in controlling the flow of electricity. Some are designed as safety devices.	T. - 162-64, 168-69 G. - 478-80
Good conductors (usually metals) are needed to carry electricity from place to place.	T. - 167-68 G. - 479-80
Good insulators increase the safety factor in everyday usage of electricity.	T. - 168-69 G. - 479-80
Safety rules and precautions should be observed when working with electricity.	

YOUR BODY AND GROWTH

GENERAL CONCEPTS	REFERENCES
Everyone grows at a different rate. At 5th grade level girls tend to grow more quickly. Later boys catch up and surpass girls.	T. - 173
The human body consists of several systems including circulatory, digestive, skeletal, muscular and respiratory. All body systems have definite functions and work together.	Throughout Unit
In every cell, there is a constantly occuring chemical change. This change produces energy needed to operate other systems.	T. - 182, 191 G. - 490, 495-96
Nutrients in food groups contribute to growth and functioning of different systems.	T. - 182, 190-98 G. - 492-93, 495-99
We need a balanced diet to supply all the nutrients needed by the body.	T. - 190-200 G. - 495-500
Energy value in food can be measured in units of heat called calories.	T. - 198-200 G. - 498-500
Glands in our bodies produce hormones which influence the rate of growth and activity of the body.	T. - 201 G. - 500-01

ANIMALS ON OUR PLANET

GENERAL CONCEPTS	REFERENCES
Scientists follow a systematic pattern in classification.	T. - Throughout Unit, 237 G. - 521
Living things are classified by structural similarities.	T. - 207-10 G. - 507-09
Each group is further classified according to distinguishing characteristics.	T. - example 214, 217, 219, 224, 227 G. - 510-15,, 516-21
Scientists have classified the thousands of different kinds of animals on earth.	
Recognition and knowledge of group differences increases man's understanding of the complexity of nature and of our total environment.	T. - 225 G. - 512-13

30

PLANTS ON OUR PLANET

GENERAL CONCEPTS	REFERENCES
Scientists have classified plants into numerous groups. The two broadest groups are seed-producing plants and plants that do not produce seeds.	T. - Throughout Unit Chart, 263 G. - 536-37
All animals are directly or indirectly dependent on the growth and reproduction of plants.	
Knowledge of the parts and functions of a seed-producing plant helps illustrate how plants grow and reproduce.	T. - 244-50 G. - 529-30
There are great distinguishing features among plants which make seeds, those that do not make seeds and the lower plants.	Throughout Unit
Plants and animals have undergone continual changes since life began on earth.	

GEOLOGY: EARTH's FORCES

GENERAL CONCEPTS	REFERENCES
The earth is constantly undergoing changes.	T. - 267-68 G. - 545-46
Natural forces produce energy which create changes in the earth's topography.	T. - 269-72, 279-81, 287-91 G. - 545-47 550-52
Constructional and destructional forces operating over millions of years have resulted in today's earth's topography.	T. - 272-79 G. - 547-50
Scientists have developed devices to measure the strength or effects of many of the forces.	T. - 283-84 G. - 551
The three main groups of rocks display unique characteristics and help reveal the history of the earth. Man has learned to use rocks or products produced from rocks.	T. - 287-91, 294-301 G. - 552-53, 556-60
The age of the earth, its basic composition, and climatic features over the centuries are factors that have caused differences in the types of rock found in various regions of the world.	T. - 299-301 G. - 559-60

CONSERVATION: SOIL AND WATER

GENERAL CONCEPTS	REFERENCES
Conservation is the wise use of all our natural resources.	T. - 310 G. - 567
Unchecked, some natural forces cause extreme destructive changes in two of our natural resources; soil and water. Man, through neglect or lack of knowledge, contributes to these destructive changes.	T. - 311 G. - 567-68
Man has learned to prevent many of these changes or to repair damage already done. Conservation procedures provide for both.	T. - 312-20 G. - 568-71
Every individual is dependent on soil and water; every individual should assume some responsibility toward conserving them.	
Knowledge of the sources of water help man in providing for its wise use.	T. - 320-25 G. - 571-73
Problems dealing with water, its supply and purity, increase as the population and demand increase.	T. - 326-27 G. - 573-74

GEOLOGY: MINERAL TREASURES

GENERAL CONCEPTS	REFERENCES
Minerals may be organic (coal, oil) or inorganic (metal) compounds.	T. - 331-33, 336-37 G. - 580-83
Ores are minerals which contain one or more valuable metals or nonmetals.	T. - 331, 341-42, 344-45 G. - 580-81, 585-86
Certain minerals are used as nuclear fuels that are a source of nuclear energy.	T. - 334-40 G. - 580-84
Man has devised methods of obtaining and effectively utilizing minerals found in the earth.	T. - 338-40, 342 G. - 582-85
Minerals have formed by natural processes that took place over long periods of time.	T. - 343 G. - 585-86

GRADE SIX

BASIC CHEMISTRY

GENERAL CONCEPTS	REFERENCES
Reinforce concepts developed in previous grades.	References to text and teacher's guide. T. - Text pages G. - Guide pages
Matter exhibits physical and chemical characteristics that enable man to classify and study it in an organized manner.	
The physical state of a substance (solid, liquid, gas) depends on the degree of motion (kinetic energy) of the molecules that make up the substance.	T. - 4-6 G. - 432-33
In physical changes the motion and/or position of molecules is changed. In chemical changes the structure of molecules is changed.	T. - 6, 14-20 G. - 432, 436-37
The molecule is the structural unit of all substances. Molecules are made up of one or more atoms. An atom is made up of electrons moving around a nucleus that is almost always made up of neutrons and protons.	T. - 7-8 G. - 433-34
An element consists of atoms that are all alike. A compound is made up of two or more kinds of atoms chemically combined.	T. - 7-11 G. - 433-35

Basic Chemistry (Cont.)

GENERAL CONCEPTS	REFERENCES
Chemical tests make it possible for the chemist to analyze or classify unknown substances.	T. - 21-39 G. - 438-43
The results of research in the field of chemistry have produced many new substances useful to man.	

SUNLIGHT AND LIFE

Green plants have the ability to use energy from the sun to combine non-living substances to make sugar. This is called the process of photosynthesis.	T. - 48-56 G. - 450-54
Plants have the ability to convert glucose into other nutrients.	T. - 56-61 G. - 450-56
There is an interdependence of all living things on earth. The food for all living things depends on the process of photosynthesis. All food chains start with green plants.	T. - 62-63 G. - 456-57
The materials from the earth and air that are used by green plants are used over and over again in continuous cycles.	T. - 64-71 G. - 457-60

PREHISTORIC LIFE

GENERAL CONCEPTS	REFERENCES
By studying fossils, geologists have traced the geologic history of the earth. The ability of a living thing to adapt to changes in its environment has played the principal role in survival of the fittest.	T. - 75-82 86-91 G. - 466-68 469-70
Radioactivity is used to date fossils, rocks and the artifacts left by ancient man.	T. - 84-85 G. - 468
Geologists have divided the history of the earth into large time divisions called eras. During each era certain types of plants and animals were dominant.	T. - 86-97 G. - 469-72
Paleontologists have studied the evidence of ancient civilization and have traced the history of man from the primitive hunter and wanderer to modern man.	T. - 94-97 G. - 471-72

SOUND WAVES

GENERAL CONCEPTS	REFERENCES
Sounds, a form of energy produced by vibrating objects, travel through matter in the form of waves.	T. - 101-03 G. - 478-79
The pitch of a sound depends on the frequency of vibration. Loudness depends on the amplitude of vibration (energy) of the vibrating source.	T. - 105-17 G. - 480-82
Sounds can be reflected, amplified and absorbed in varying degrees. The amount of sound energy that is absorbed or reflected (echoes) by a material depends on the nature of the material.	T. - 126-27 G. - 484
Human sounds are produced by the larynx and are controlled by muscles in the mouth, throat and chest. We can hear a limited range of sounds.	T. - 110, 118-19 G. - 481-83, 397
The energy of a sound wave is transmitted from molecule to molecule of the substance carrying the sound.	T. - 120-25 G. - 483-84

SOUND AND COMMUNICATION

GENERAL CONCEPTS	REFERENCES
Equipment has been devised to allow widely separated people to communicate with each other.	T. - 130-31 G. - 490-91
Sound energy is used to control electrical energy which is sent over wires and converted back to sound or mechanical energy.	T. - 132-49 G. - 490-95, 488
It is possible to store messages for future use by means of devices such as tape recordings and phonograph records.	T. - 145-49 G - 493-95

LIGHT WAVES

The exact nature of light is still unknown. Light is a form of energy that shows characteristics of both particles and waves.	T. - 510-55 G - 500-01
Other forms of energy can be transformed into light energy. Light energy can be transferred to other forms.	T. - 165, 189 G. - 501-02, 507-08
The color of light depends on the frequency of the light waves. The brightness depends on the amplitude of the waves.	T. - 167-68 G. - 501-02

Light Waves (Cont.)

GENERAL CONCEPTS	REFERENCES
White light may be separated into the colors of the solar spectrum.	T. - 169-71 G. - 502-03
Not all light is visible. Infrared and ultraviolet radiation are useful to man.	T. - 172-74 G. - 502-04
Light travels at the rate of 186,000 miles per second.	T. - 175-76 G. - 504-05
Materials are transparent, transluscent or opaque to light.	T. - 179-80 G. - 505 .
Images in smooth surfaces are seen by reflected light.	T. - 181-83 G. - 506-07
Objects have the color of the light that they either reflect or transmit.	T. - 185-88 G. - 508
Light energy is converted to heat energy when it is absorbed by a material.	T. - 89 G. - 508

OPTICAL INSTRUMENTS

GENERAL CONCEPTS

REFERENCES

Almost all optical instruments contain lenses or mirrors which are used to produce images that are larger than the images seen without the instruments. Some instruments store the images on tape or film.

Optical instruments are the tools of the astronomer, medical men, communication personnel and persons in a variety of other fields. Man uses lenses directly to improve his eyesight.

RADIO AND TELEVISION

A wire through which an electric current is flowing is surrounded by a magnetic field.

T. - 219
G. - 529-30

When a wire is moved through a magnetic field an electric current is generated in the wire.

T. - 220

If the current in a wire varies the electromagnetic field around the wire is sent out into space as electromagnetic energy in the form of waves.

T. - 221-23

Radio and television transmitters send out electromagnetic energy which is picked up by receivers, amplified and changed to sound or light energy.

T. - 226-31

THE NERVOUS SYSTEM

GENERAL CONCEPTS	REFERENCES
Each of our sensory organs is adapted to receive stimuli from our environment.	T. - 236-60 G. - 539-46
Impulses or messages are conducted over nerves from the sensory organs to the brain.	T - 262 G. - 546-47
Nerves in the brain transfer messages from sensory nerves to motor nerves.	T. - 262, 266-67 G. - 548
Messages from the brain to the muscles and glands are carried over motor nerves.	T. - 263 G. - 548
It takes a measurable time for messages to travel through a nerve circuit.	T. - 267-68 G. - 549
The brain is made up of three parts that control the associative, motor and automatic functions of the body.	

ASTRONOMY: TIME AND SPACE

GENERAL CONCEPTS	REFERENCES
There is an orderly pattern of motion of celestial bodies in the skies. The patterns of the apparent daily motion of the sun, the motion of the moon and the apparent north-south motion of the sun are used to give us our time units of the day, month and year.	T. - 284-90, 293-94, 304-08, G. - 557-60, 560-62, 565-68, 573
The revolution of the earth around the sun together with the tilt of the earth's axis causes seasons.	T. - 286-90 G. - 558-60
Observations made by astronomers have resulted in the replacement of once accepted hypothesis about the structure of the universe by new hypotheses, theories and laws.	T. - 291.92, 295 G. - 560-61, 562-64
It is possible to explain and predict lunar and solar eclipses by using now accepted explanations of the motion of the sun, earth and moon.	T - 297-99 G. - 563-65
Changes in the motion and brightness of the planets can be explained by use of the solar system theory.	T. - 299-302 G. - 565-66
Astronomical distances are so great that large measuring units have been devised.	T. - 313 G. - 568-70
Distances in space can be measured by the process of triangulation and the use of scales and mathematics.	T. - 309-12 G. - 568-70

THEORIES OF ASTRONOMY

GENERAL CONCEPTS	REFERENCES
Discovering patterns of relationships in carefully compiled data proved the key to Kepler's discoveries.	T. - 318-19, 323 G. - 576-79
The invention of and development of the modern telescope increased the ability of astronomers to study objects in the skies and formulate astronomical theories.	T. - 320-22 G. - 576-78
Many objects that are smaller than planets are known to exist in the solar system.	T. - 334-35
Newton's law of gravity and his laws of motion are used to explain the patterns of motion of objects in space.	T. - 324-333 G. - 578-81
There is an unending search for knowledge regarding the origin and structure of the universe. Scientists continue gathering data to test old and new hypotheses.	T. - 334-39 G. - 581-82
At present, travel to solar systems beyond our solar system seems unlikely, but information in the form of radio waves is being received from outer space and is being interpreted by astronomers.	T. - 339 G. - 581-82

OCEANOGRAPHY AND ENGINEERING

GENERAL CONCEPTS	REFERENCES
Oceanography is the study of the oceans and ocean basins.	
Oceanography is not an isolated science. Geologists, engineers, paleontologists and many other specialists contribute to its findings.	
The presence of valuable minerals in seawater has been determined by chemical analysis. At present, most methods for the removal of these minerals are too costly.	T. - 347-48 G. - 590-91
Oceans influence climate, the shape of the earth's surface (topography). They support abundant forms of life and help determine man's activities.	T. - 348-52 G. - 590-91
The ocean becomes more important as man explores it as a source of food, fresh water and minerals for the world's expanding population.	T. - 348-50 G. - 590-91
Animals in the oceans are dependent on small green plants for their survival. (Review food chains)	T. - 349-5[illegible] G. - 590-91

GENERAL CONCEPTS	REFERENCES
The floor of the ocean is being explored by means of reflected sound waves and underwater craft. This exploration is necessary in the search of minerals and in order to plot the surface of the floor of the ocean as an aid to underwater navigation.	T. - 350-51, 354, 377 G. - 589-90, 592
Ocean currents are studied to gain information about their causes, to study their effects on climate and to aid in ship navigation.	T. - 354-57 G. - 590-92